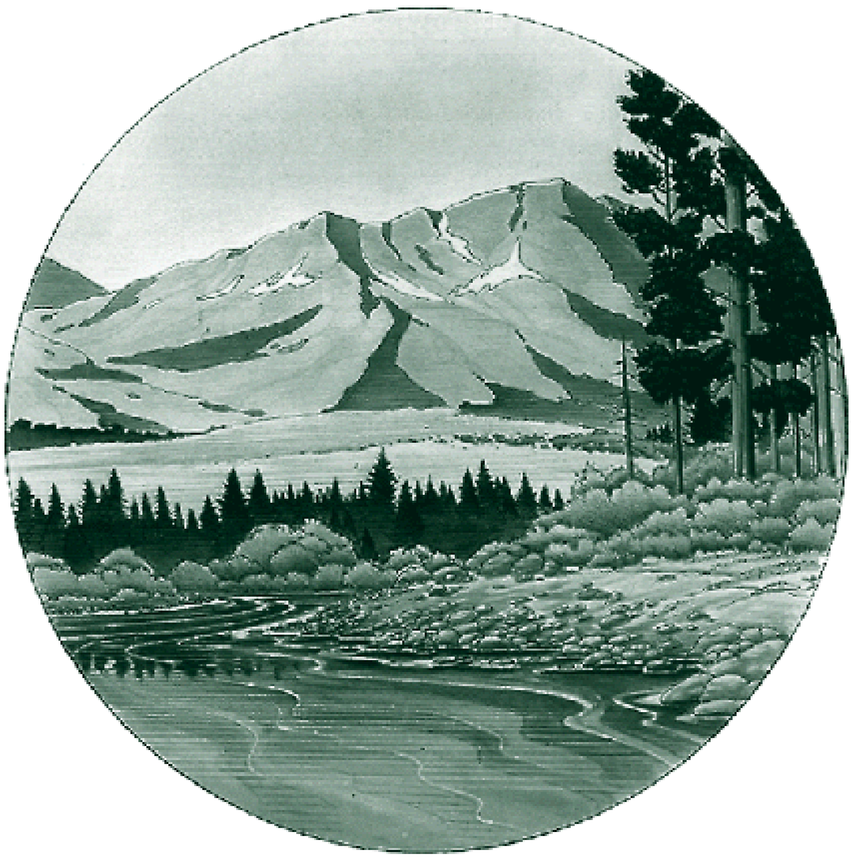
March 1999

ASOTIN CREEK INSTREAM HABITAT ALTERATION PROJECTS 1998 HABITAT EVALUATION SURVEYS



DOE/BP-00006230-2

This report was funded by the Bonneville Power Administration (BPA), U.S. Department of Energy, as part of BPA's program to protect, mitigate, and enhance fish and wildlife affected by the development and operation of hydroelectric facilities on the Columbia River and its tributaries. The views of this report are the author's and do not necessarily represent the views of BPA.

This document should be cited as follows:

Bumgarner, Joseph D., Arthur E. Viola, Mark L. Schuck - Washington Department Of Fish And Wildlife, 1999, Asotin Creek Instream Habitat Alteration Projects-1998 Habitat Evaluation Surveys, Report to Bonneville Power Administration, Contract No. 00006230, Project No. 199905400, 19 electronic pages (BPA Report DOE/BP-00006230-2)

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ASOTIN CREEK
INSTREAM HABITAT ALTERATION PROJECTS
1998 HABITAT EVALUATION SURVEYS

by

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March, 1999

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SECTION 1: INTRODUCTION

The Asotin Creek Model Watershed Master Plan was completed 1994. The plan was developed by a landowner steering committee for the Asotin County Conservation District (ACCD), with technical support from the various Federal, State and local entities. Actions identified within the plan to improve the Asotin Creek ecosystem fall into four main categories, 1) Stream and Riparian, 2) Forestland, 3) Rangeland, and 4) Cropland. Specific actions to be carried out within the stream and in the riparian area to improve fish habitat were, a) create more pools, b) increase the amount of large organic debris (LOD), c) increase the riparian buffer zone through tree planting, and d) increase fencing to limit livestock access; additionally, the actions are intended to stabilize the river channel, reduce sediment input, and protect private property. Fish species of main concern in Asotin Creek are summer steelhead (*Oncorhynchus mykiss*), spring chinook (*Oncorhynchus tshawytscha*), and bull trout (*Salvelinus confluentus*). Spring chinook in Asotin Creek are considered extinct (Bumgarner et al. 1998); bull trout and summer steelhead are below historical levels and are currently as “threatened” under the ESA.

In 1998, 16 instream habitat projects were planned by ACCD along with local landowners. The ACCD identified the need for a more detailed analysis of these instream projects to fully evaluate their effectiveness at improving fish habitat. The Washington Department of Fish and Wildlife’s (WDFW) Snake River Lab (SRL) was contracted by the ACCD to take pre-construction measurements of the existing habitat (pools, LOD, width, depth, etc...) within each identified site, and to eventually evaluate fish use within these sites. All pre-construction habitat measurements were completed between 6 and 14 July, 1998. 1998 was the first year that this sort of evaluation has occurred. Post construction measurements of habitat structures installed in 1998, and fish usage evaluation, will be conducted in 1999. As such, this report is confined to 1998 habitat data summaries for each site, with no analytical evaluation.

SECTION 2: MATERIALS AND METHODS

<u>Site Locations:</u> All 1998 habitat project locations were pre-determined by local landowners and ACCD with input from WDFW fish and habitat biologists. Rough maps and pre-construction photographs of each site were supplied to the SRL before habitat measurements were collected. Once on site, SRL biologists then determined an upper and lower end of each site which would include habitat improvement construction areas. All sites were marked with a painted metal stake at the upper end, so that in 1999, habitat measurements could be collected from identical river locations for post-construction comparison.

<u>Habitat Measurements:</u> Basic habitat measurements were recorded for each site. Measurements included 1) site length, 2) maximum and mean site depth, 3) mean wetted width 4) mean thalweg depth, 5) quantitative and qualitative counts of woody debris, 6) number of pools, 7) pool quality, 8) pool area, 9) pool depth, and 10) a flourescent dye retention rate.

<u>Materials:</u> Two, 2 m measuring rods (marked every 0.5 m), one 30 m measuring tape (marked every 0.1 m), one 5 gallon bucket, Flourescent Dye, stopwatch, data forms.

Methods: Starting at the upper end of each site, measurements of channel wetted width and water depths were collected. Two people held each end of a metric measuring tape approximately perpendicular to the stream flow on the wetted edge of opposite stream banks. Depth measurements were taken and recorded to the nearest centimeter every meter across the stream. Depth measurements on Charley Creek were taken every 0.5 m. The thalweg depth of each transect was also measured. Surveyors then measured ten meters downstream, make the same measurements, and repeat this process to the bottom end of each site. If the stream channel split, the same width transect would be made. Depth measurements would occur as usual, but islands would be recorded as "dry". Each measurement recorded as "dry" was later subtracted from total transect width, yielding total wetted width for that particular transect. The thalweg measurement in split channels was taken in the channel with the largest volume of water.

LOD was measured only if it met the following criteria; 1) must be touching or within 30 cm (one foot) of the water surface, 2) must be greater than 15 centimeters in width (six inches), and 3) must be stationary (held firmly in place). Portions of a particular LOD that were located outside the wetted stream bank were not measured, while the portion in the stream was included. All pools were measured if they met the following two criteria, pools; 1) must be greater than 30 cm x 30 cm in surface area, and 2) have a minimum depth of 15 cm. Pools were measured by length, width, three to five depths, a maximum depth, and a pool rating (Table 1) was then determined.

Table 1. Pool quality ratings for streams between 20 and 60 feet in width (from Platts et al 1985).

Key	Description	Pool Rating
1A	If the max. pool diameter is within 10% of the mean stream width of study site..........	Go to 2A, 2B
1B	If the max. pool diameter exceeds the mean stream width of study site by ≥10%..........	Go to 3A, 3B
1C	If the max. pool diameter is less than the mean stream width of study site by ≤10%.....	Go to 4A, 4B, 4C
2A	If the pool is less than 0.6 m (2 ft) in depth..	Go to 5A, 5B
2B	If the pool is more than 0.6 m in depth..	Go to 3A, 3B
3A	If the pool is over 0.9 m (3 ft) in depth, or if the pool is over 0.6 m in depth and has abundant fish cover [1]...	Rate 5
3B	If the pool is less than 0.6 m in depth, or if the pool is between 0.6 m and 0.9 m and the pool lacks fish cover..	Rate 4
4A	If the pool is over 0.6 m with intermediate [2] or better cover..	Rate 3
4B	If the pool is less than 0.6 m in depth but pool cover for fish is intermediate or better.....................	Rate 2
4C	If the pool is less than 0.6 m in depth and pool cover is classified as exposed [3]................................	Rate 1
5A	If the pool has intermediate to abundant cover...	Rate 3
5B	If the pool has exposed cover conditions..	Rate 2

1 If cover is abundant, the pool has excellent instream cover and most of the perimeter of the pool has fish cover.
2 If cover is intermediate, the pool has moderate instream cover and one-half of the pool perimeter has fish cover.
3 If cover is exposed, the pool has poor instream cover and less than one-fourth of the pool perimeter has any fish cover.

Once habitat improvements are completed, channel width and depth will change in portions of each site. Also, river flow will deflect off objects within the stream, changing river shape and complexity. Because of those changes, water velocity (meters/second) within the site will also change. For a rough estimate of water velocity through the site, we timed the rate at which a flourescent dye traveled down the thalweg from upper to lower end of the site. The dye was mixed in a five gallon bucket of water, then quickly poured from the bucket into the thalweg. The dye was timed to a point when the dye in the water reached a consistent dark intensity at the lower end of the site. This generally occurred 10-20 seconds after the first traces of dyed water reached the lower end. In addition to dye rate, stream flows collected by the United States Geological Survey (USGS) gauge station will be used to calibrate measurements between years. Stream flows during survey dates were not available at time of printing.

All collected data were then entered into the computer and additional calculations made to describe the characteristics of the site. Wetted surface area and volume, and wetted width-to-depth ratios were calculated from transects. Standard Deviation (SD) of thalweg depth was calculated to represent the complexity of the site. A large thalweg SD indicates more depth variation (i.e. riffles to pools to runs), where a small thalweg SD indicates less habitat diversity (example: stream is all a shallow riffle). Also, the percent of the site in LOD and pools was related to wetted surface area and volume of the site, further describing complexity. A mean pool rating for each site was also calculated, indicating the most common type of pools present within each site.

Snorkeling: In order to fully evaluate fish utilization of habitat alterations, it was decided that snorkel surveys (Griffith 1981, Schill and Griffith 1984) should be used to quantify fish usage (densities of fish/100 m^2) within each improved site. Control sites will be established near habitat alteration sites. Statistical tests (student *t*-test, Zar 1984) will then be conducted to determine if there are significant differences between treatment and control sites.

Two snorkelers will swim upstream side by side through the site. Only a portion of each site, which will include some habitat improvement structure (vortex weir, LOD, rock barbs, etc...), will be snorkeled for juvenile steelhead densities. Each snorkel site will be 20 m in length. Depending on site length and the number, and type, of habitat improvements made, multiple snorkel sites may exist within one habitat alteration site. Juvenile steelhead in Asotin Creek range from 0-2 years in age (Schuck et al. 1997) and are found in most areas of the creek, with the youngest age fish in the near shore areas. Further, we have tested differences between electrofishing and snorkeling estimates and determined it was not possible to accurately count Age 0 steelhead by snorkel techniques (Schuck et al. 1996). Based on that study, only steelhead of Age 1+ will be counted for evaluation purposes. Densities of spring chinook and bull trout are not large enough for statistical tests.

Contrary to the Statement of Work (Item #2), 1998 construction sites were not snorkeled for densities of juvenile salmonids in 1998 for the following reasons.

- Site maps given to SRL personnel were not drawn to scale or showed exact placement (within 10 m) of proposed alterations. Since snorkel sites will be 20 m in length, it would have been very likely that establishing a snorkel site within the proposed alterations would have missed the alteration completely.

- Fish densities are directly dependent on the number of successful spawning adults from previous years and environmental factors, and as such, can vary widely between years. Therefore, making comparisons of fish densities and utilization between 1998 and 1999 pre and post-construction without control sites would not be biologically sound.

All 1998 construction sites (treatment) and randomly selected index sites (control) outside of the habitat altered area will be established and snorkeled in 1999. Direct comparisons will then be made between altered and non-altered areas by stratum.

Backwater Rearing: Two backwater rearing sites were identified within the 1998 sites (Hood #8, Theissen #10). These backwater rearing areas may provide critical rearing habitat for juvenile salmonids because they provide a refuge during high water events. Spring-fed backwater rearing areas have been documented as critical to increasing coho salmon (*Onchorynchus kisutch*) survival rates in mild climates (Sandercock 1991). However, use of these backwater areas by spring chinook, steelhead, or bull trout in an area of extreme summer and winter temperatures, and throughout the year is unknown. Low water flow and high summer temperatures may limit the use of these areas during the summer months. Likewise, low flows and extreme cold temperatures during the winter may completely cover these areas with ice. During the fall of 1998 and through the winter, spring, and summer of 1999, SRL personnel will begin documenting fish densities within the two identified backwater areas. Documentation of fish densities will continue for one year. Summer rearing densities within these backwater rearing location can then be compared to other fish densities throughout the creek.

SECTION 3: RESULTS

Sites measured in the following strata of Asotin creek were as follows: a) North Fork Asotin Creek-0, b) South Fork Asotin Creek-2, c) Charley Creek-4, d) Mainstem Asotin Creek above Kearney Gulch-9, and e) Mainstem Asotin Creek below Kearney Gulch-2.

South Fork Asotin Creek: One site was originally identified in the South Fork, but later was split into two parts because of the distance between construction areas. Instream structures to be placed in the sites were vortex weirs, and LOD along exposed and eroding banks. Overall, both sites were shallow and less than 2.5% of the total site surface area contained LOD. Pool number and quality was low (Table 2 and 3). About 86% of the pools in both sites combined were rated as a class 1. The SD of thalweg depths was low in both sites, indicating low site complexity.

Table 2. South Fork Asotin Creek site WDFW 19a and 19b pool classifications, 1998.

	1998 Pool Classifications					1999 Pool Classifications				
Site Name	1	2	3	4	5	1	2	3	4	5
WDFW 19a	10	0	0	0	0	To be completed in 1999				
WDFW 19b	2	2	0	0	0					
Total	**12**	**2**	**0**	**0**	**0**					
Percent	**85.7**	**14.3**	**0.0**	**0.0**	**0.0**					

Table 3. Summary of 1998 habitat measurements in South Fork Asotin Creek construction sites.

	WDFW #19a			WDFW #19b		
Measurement	1998	1999	%	1998	1999	%
Site length (m)	183.0			62.3		
Mean wetted width (m)	5.49			6.24		
St. Dev. wetted width (m)	1.62			0.82		
Mean depth (cm)	12.52			8.14		
St. Dev. depth (cm)	7.11			6.55		
Mean thalweg (cm)	23.95			20.29		
St. Dev. thalweg(cm)	4.12			5.15		
Wetted surface area (m^2)	1004.67			388.75		
Wetted volume (m^3)	125.78			31.64		
Width : Depth ratio	43.85			76.66		
Number of LOD	1			1		
LOD area (m^2)	0.20			9.08		
% LOD area	0.02			2.34		
Number of pools	10			4		
Mean pool depth (cm)	0.23			0.28		
Pool area (m^2)	6.52			18.43		
% pool area	0.65			4.74		
Pool volume (m^3)	1.57			6.07		
% pool volume	1.25			19.18		
Mean Pool Rating	1.00			1.50		
Stream flow (m^3/s)	NA			NA		
Dye rate (m/s)	0.52			0.56		

Charley Creek: Of six sites originally identified, four were measured. Two sites near the mouth of Charley Creek (CC) were dropped before evaluation measurements began. Instream structures to be constructed were vortex weirs plus at least one rootwad associated with each. LOD and rock barbs were to placed along eroding banks to redirect water flow and stop erosion.

Mean pool ratings were generally very low (all <1.8), with about 60% of the pools rated to class 1 (Table 4). All four sites measured had virtually no LOD present (Table 5), representing less than 0.5% of the total area in any given site. Standard deviations of thalweg depth were all low, indicating low site complexity.

Table 4. Summary of Charley Creek sites #15-18 pool classifications.

	1998 Pool Classifications					1999 Pool Classifications				
Site Name	1	2	3	4	5	1	2	3	4	5
CC #15	7	3	0	0	0	To be completed in 1999				
CC #16	3	0	0	0	0					
CC #17	2	7	0	0	0					
CC #18	8	3	0	0	0					
Total	**20**	**13**	**0**	**0**	**0**					
Percent	**60.6**	**39.4**	**0**	**0**	**0**					

Mainstem Asotin Creek above Kearney Gulch: Eight sites were identified, but one site (Theissen #9) was split into two areas because of the distance between construction areas. Instream habitat alterations identified for these 9 sites were vortex rock weirs, rock barbs, root wad revetments, LOD, creation of backwater rearing areas, and stream meander reconstruction (Koch #1) which include nearly all of the above structures.

Mainstem Asotin Creek is larger and has more water flow than the two forks; this probably accounts for the difference in pool quality. However, no site had more than 7% LOD (Table 6 and 7). Overall, pools measured within the nine sites were of better quality than measured in the South Fork or Charley Creek, with some pools rated in Class 3 (14%) and Class 4 (1%) (Table 8).

Table 5. Summary of 1998 habitat measurements in Charley Creek construction sites.

	CC #15			CC #16			CC #17			CC #18		
Measurement	1998	1999	%	1998	1999	%	1998	1999	%	1998	1999	%
Site length (m)	160.0			269.8			243.0			230.0		
Mean wetted width (m)	3.56			3.77			4.29			3.74		
St. Dev. wetted width (m)	0.96			1.02			1.58			0.57		
Mean depth (cm)	18.41			12.84			11.58			15.52		
St. Dev. depth (cm)	10.37			6.53			7.11			7.59		
Mean thalweg (cm)	30.65			21.74			22.44			24.92		
St. Dev. thalweg(cm)	7.82			3.77			4.47			7.26		
Wetted surface area (m^2)	569.60			1017.15			1042.47			860.20		
Wetted volume (m^3)	104.86			130.60			120.72			133.50		
Width : Depth ratio	19.34			29.36			37.05			24.10		
Number of LOD	4			1			1			0		
LOD area (m^2)	1.48			0.20			1.04			0.00		
% LOD area	0.26			0.02			0.10			0.00		
Number of pools	10			3			9			11		
Mean pool depth (cm)	28.24			20.06			30.95			22.77		
Pool area (m^2)	15.75			2.86			22.67			6.51		
% pool area	2.77			0.28			2.17			0.76		
Pool volume (m^3)	5.44			0.53			7.83			1.59		
% pool volume	5.19			0.41			6.49			1.19		
Mean Pool Rating	1.30			1.00			1.78			1.27		
Stream flow (m^3/s)	NA			NA			NA			NA		
Dye rate (m/s)	0.56			0.50			0.57			0.68		

Table 6. Summary of 1998 habitat measurements in five mainstem Asotin Creek construction sites above Kearney Gulch.

	F. Koch #1			F. Koch #2			F. Koch #3			M. Koch #6			Hood #8		
Measurement	1998	1999	%	1998	1999	%	1998	1999	%	1998	1999	%	1998	1999	%
Site length (m)	182.0			145.0			316.0			165.8			58.2		
Mean wetted width (m)	7.66			11.06			10.31			11.21			7.80		
St. Dev. wetted width (m)	1.04			3.09			5.66			4.93			1.00		
Mean depth (cm)	28.29			24.35			27.95			22.76			35.84		
St. Dev. depth (cm)	13.66			12.16			15.63			18.40			18.85		
Mean thalweg (cm)	44.00			41.60			27.95			52.53			60.17		
St. Dev. thalweg(cm)	10.74			5.70			15.63			20.22			22.65		
Wetted surface area (m^2)	1394.12			1603.70			3257.96			1858.62			453.96		
Wetted volume (m^3)	394.40			390.50			910.60			423.02			162.70		
Width : Depth ratio	27.08			45.42			36.89			49.25			21.76		
Number of LOD	14			0			14			4			3		
LOD area (m^2)	10.81			0.00			21.45			106.28			5.62		
% LOD area	0.78			0.00			0.66			5.72			1.24		
Number of pools	14			5			33			9			3		
Mean pool depth (cm)	30.22			30.29			37.22			43.51			46.49		
Pool area (m^2)	34.05			62.18			119.01			45.56			26.34		
% pool area	2.44			3.88			3.65			2.45			5.80		
Pool volume (m^3)	13.73			22.15			63.44			22.76			20.75		
% pool volume	3.48			5.67			6.97			5.38			12.75		
Mean Pool Rating	1.36			1.60			1.67			2.00			2.33		
Stream flow (m^3/s)	NA			NA			NA			NA			NA		
Dye rate (m/s)	0.90			1.01			0.67			1.02			0.95		

Table 7. Summary of 1998 habitat measurements in four mainstem Asotin Creek construction sites above Kearney Gulch.

	Thiessen #9a			Thiessen #9b			Thiessen #10			J. Koch #11		
Measurement	1998	1999	%	1998	1999	%	1998	1999	%	1998	1999	%
Site length (m)	100.0			116.0			220.0			115.9		
Mean wetted width (m)	9.01			11.32			11.47			11.63		
St. Dev. wetted width (m)	3.31			1.84			3.67			2.29		
Mean depth (cm)	29.64			23.99			22.53			21.33		
St. Dev. depth (cm)	13.50			14.96			14.20			13.43		
Mean thalweg (cm)	48.91			44.42			44.70			40.08		
St. Dev. thalweg(cm)	8.60			12.21			12.93			14.56		
Wetted surface area (m^2)	901.01			313.12			2523.40			1347.92		
Wetted volume (m^3)	267.06			315.02			568.52			287.51		
Width : Depth ratio	30.40			47.19			50.91			54.52		
Number of LOD	1			3			30			12		
LOD area (m^2)	0.75			26.08			157.24			16.74		
% LOD area	0.08			1.99			6.23			1.24		
Number of pools	7			5			22			16		
Mean pool depth (cm)	44.28			30.78			38.75			36.82		
Pool area (m^2)	21.39			30.96			70.71			57.79		
% pool area	2.37			2.36			2.80			4.29		
Pool volume (m^3)	7.32			16.06			30.36			24.85		
% pool volume	2.74			5.10			5.34			8.64		
Mean Pool Rating	1.00			1.80			2.00			1.56		
Stream flow (m^3/s)	NA			NA			NA			NA		
Dye rate (m/s)	0.90			0.90			0.97			1.10		

Table 8. Mainstem Asotin Creek above Kearney Gulch pool classifications.

Site Name	1998 Pool Classifications 1	2	3	4	5	1999 Pool Classifications 1	2	3	4	5
F. Koch #1	11	1	2	0	0	To be completed in 1999				
F. Koch #2	2	3	0	0	0					
F. Koch #3	4	16	3	0	0					
M. Koch #6	2	5	2	0	0					
Hood #8	1	1	0	1	0					
Thiessen #9a	7	0	0	0	0					
Thiessen #9b	2	2	1	0	0					
Thiessen #10	4	14	4	0	0					
J. Koch #11	10	3	3	0	0					
Total	**43**	**45**	**15**	**1**	**0**					
Percent	**41.3**	**43.3**	**14.4**	**1.0**	**0.0**					

Mainstem Asotin Creek below Kearney Gulch: Three sites were identified, but two sites were located next to each other, and it was not possible for SRL personnel to differentiate between the two. Those two sites were combined into one evaluation site.

In contrast to sites measured above Kearney Gulch, pool ratings decreased, with more pools falling into Class 1 and 2 (Table 9). As with other sites measured, the number and percent of LOD were low (Table 10).

Table 9. Mainstem Asotin Creek below Kearney Gulch pool classifications.

Site Name	1998 Pool Classifications 1	2	3	4	5	1999 Pool Classifications 1	2	3	4	5
Bogar/Thompson	69	17	4	0	0	To be completed in 1999				
Flynn	5	1	1	0	0					
Total	**74**	**18**	**5**	**0**	**0**					
Percent	**76.3**	**18.6**	**5.1**	**0.0**	**0.0**					

Table 10. Summary of 1998 habitat measurements in mainstem Asotin Creek construction sites

below Kearney Gulch.

Measurement	Bogar/Thompson 1998	1999	%	Flynn 1998	1999	%
Site length (m)	570.0			50.0		
Mean wetted width (m)	10.61			11.40		
St. Dev. wetted width (m)	2.43			0.64		
Mean depth (cm)	28.04			22.78		
St. Dev. depth (cm)	15.18			11.30		
Mean thalweg (cm)	44.69			37.33		
St. Dev. thalweg(cm)	11.16			8.98		
Wetted surface area (m^2)	6047.70			570.00		
Wetted volume (m^3)	1695.78			129.85		
Width : Depth ratio	37.84			50.04		
Number of LOD	14			1		
LOD area (m^2)	31.16			1.29		
% LOD area	0.52			0.23		
Number of pools	90			7		
Mean pool depth (cm)	31.63			29.82		
Pool area (m^2)	118.40			14.98		
% pool area	1.96			2.63		
Pool volume (m^3)	55.88			7.28		
% pool volume	3.30			5.61		
Mean Pool Rating	1.28			1.43		
Stream flow (m^3/s)	NA			NA		
Dye rate (m/s)	0.99			1.22		

SECTION 4: DISCUSSION

Considering that 1998 was the first year in which extensive evaluation was conducted on instream habitat alteration projects, very few conclusions can be reached as to wether the projects will provide benefits to the salmonid populations. For the 1998 report, only general observations can be made.

As identified within the Model Watershed Plan, Asotin Creek and its tributaries have been significantly impacted by human activities and natural catastrophic events since the turn of the century. Lack of pools and LOD, and overall channelization have greatly altered the creek and impacted the fish population. The habitat measurements taken in 1998 would support those claims. Overall, large deep pools (adult fish habitat) were lacking, and the pools that were present were generally of poor quality and would provide little habitat for juvenile fish. The majority of pools measured were associated with small to medium boulders in the stream which create a "pocket" of calm water. Unless adequate cover is present in these types of pools (woody debris or surface turbulence), fish utilization is minimal. LOD is also significantly lacking from areas of the creek surveyed. In no instance did any 1998 site measured have more than 6.5 % of the total surface area with LOD present, and most were less than 1.0%. An increase in LOD in the stream will greatly improve fish habitat by creating natural pools and/or providing cover from predators, but also can contribute to bank stability.

Instream structures (vortex weir, LOD, rootwad revetments, riparian plantings, etc..) to be added in 1998 should increase pool number, pool quality, cover, reduce water velocity and sediment within each of the sites, potentially creating more fish rearing habitat, and perhaps increasing the over all survival rate of salmonids in these areas. Steelhead populations and survival rates were shown to increase following similar type projects in Asotin Creek and the Tucannon River in the early 1980's (Viola et al. 1991). However, those projects were located higher in the watershed compared to the 1998 habitat alterations in Asotin Creek, and overall results may be different. These habitat alteration projects, and other measures identified in the Asotin Creek Model Watershed Plan may play a key role in stabilizing, restoring, or rebuilding healthy populations of salmonids in the Asotin Creek basin. Long-term monitoring and evaluation of these habitat alteration projects into the future will be critical in determining the value of such actions.

ACKNOWLEDGEMENTS

We thank Brad Johnson of the Asotin County Conservation District for funding this evaluation work. Brad also provided rough site maps and photographs, descriptions of proposed instream structures to be placed within each site, and guidance to the location of each proposed habitat alteration site.

We thank all of the Asotin County landowners for their participation in stream restoration efforts.

We thank the crew of the Salmon Corps. Their added assistance in data collection allowed the evaluation work to be conducted in a timely manner.

We thank the field crew of the Snake River Lab, and in particular our temporary technicians John Skidmore and Justin Steinhoff who entered and verified all data collected into a main database which provided the summaries presented in this report.

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